NOTES BY THE EDITOR.

MEXICAN CLIMATOLOGICAL DATA.

In order to extend the isobars and isotherms southward so that the students of weather, climate and storms in the United States may properly appreciate the influence of the conditions that prevail over Mexico the Editor has compiled the following tables from the current numbers of the Boletin Mensual as published by the Central Meteorological Observatory of Mexico. The data there given in metric measures have been converted into English measures. The barometric means are as given by mercurial barometers under the influence of local gravity, and therefore need reductions to standard gravity, depending upon both latitude and altitude; the influence of the latter is rather uncertain, but that of the former is well known. For the sake of conformity with the other data published in this REVIEW these corrections for local gravity have not been applied.

Mexican data for June, 1896.

Stations.	Altitude.	Mean barometer.	Mean temperature.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Cloud.
	Feet.	Inch.	°F.	%	Inch.		
Colima (Seminario)		28.25	82.0	68	3.37	ssw.	sw.
Colima	1,291.2		83.8				
Guadalajara (Obs. d. Est.)	5,188.0	24.97	75.2	81	13.59	....	ne.
Guanajuato	6,761.3	23.68	69.8	47	3.95	ene.	ene.
Jalapa	4,757.3	25.55	69.4	75	15.61	n.	
Leon	5,901.0	24.28	73.8	42	1.15	ene.	
Magdalena (Sonora)			83.5		0.67		
Mazatlan	24.6	29.86	84.2	74	0.47	w.	e.
Merida	50.2	29.88	81.5	79	11.57	e.	e.
Mexico (Obs. Cent.)	7,488.7	23.08	65.5	54	1.17	n.	ne.
Mexico (E. N. de S.)	7,480.3	23.11	66.6	56	1.10	ne.	
Morelia (Seminario)	6,401.0	23.95	66.9	62	2.64	ne.	ne.
Oaxaca	5,164.4	25.06	72.9	63	4.22	nw.	ne.
Pabellon	6,312.4						
Pachuca	7,956.3	22.59	59.5	68	0.58	nne.	
Puebla (Col. Cat.)	7,112.0	23.43	67.5	61	5.78		
Queretaro	6,069.7	24.18	70.0	53	2.50	e.	e.
Saltillo (Col. S. Juan)	5,376.7						
San Luis Potosi	6,201.9	24.15	70.5	53	0.38	e.	e.
Silao	6,063.1	24.25	74.5	57	1.71	ne.	ne.
Toluca	8,612.4	29.91	61.3	44	3.75	ene.	ne.
Trejo (Hac. Silao, Gto.)					3.71		
Zacatecas	8,015.2	22.55	68.7	48	1.51	e.	ne.
Zapotlan (Seminario)	5,124.8	25.05	73.9		6.17	se.	ne.

Mexican data for July, 1896.

Stations.	Altitude.	Mean barometer.	Mean temperature.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Cloud.
	Feet.	Inch.	°F.	%	Inch.		
Colima (Seminario)		28.30	80.6	72	4.98	wsw.	
Colima	1,291.7		82.0				
Culiacan	112.2						
Guadalajara (Obs. d. Est.)	5,188.0	25.02	70.9	83	13.60	nnw.	ne.
Guanajuato	6,761.3	23.72	68.2	53	1.70	ene.	e.
Jalapa	4,757.3	25.61	66.9	87	14.79	e.	
Lagos (Liceo Guerra)	6,274.5	24.21	70.3	55	1.88	e.	e.
Leon	5,901.0	24.33	72.0	53	1.86	se.	ene.,ese.
Magdalena (Sonora)			84.2			s., w.	n.
Mazatlan	24.6	29.90	85.1	76	7.12	nw.	e., ne.
Merida	50.2	29.98	81.0	77	3.81	ne.	e.
Mexico (Obs. Cent.)	7,488.7	23.11	63.5	65	3.92	n.	ne.
Mexico (E. N. de S.)	7,480.5	23.06	65.7	69	3.74	nw.	
Morelia (Seminario)	6,401.0	24.00	63.5	71	5.19	ne.	ne.
Oaxaca	5,164.4	25.10	72.3	64	2.57	nw.	ne.
Pabellon	6,312.4	24.01	71.2	57	2.61	se.	e.
Pachuca	7,956.3	22.56	57.6	69	0.47	se.	ne.
Puebla (Col. Cat.)	7,112.0	23.45	65.8	64	4.17		
Queretaro	6,069.7	24.22	69.1	61	1.02	e.	ene.
Saltillo (Col. S. Juan)	5,376.7	24.97	73.8	65	2.72	ne.	n.
San Luis Potosi	6,201.9	24.20	63.7	63	0.26	e.	e.
Silao	6,063.1	24.29	72.7	68	3.40	ne.	ne.
Tacubaya (Obs. Nac.)	7,620.2						
Toluca	8,612.4	21.96	60.3	63	6.46	ese.	ne.
Trejo (Hac. Silao, Gto.)					3.16		
Zacatecas	8,015.2	22.59	65.1	61	1.61	e.	e.
Zapotlan (Seminario)	5,124.8	25.09	71.1		10.26		

THE PERIODICITY OF GOOD AND BAD SEASONS.

A lecture on the above subject, delivered June 3, 1896, by H. C. Russell, director of the astronomical observatory and also of the meteorological service at Sydney, N. S. W., is published in an abridged form in the English journal Nature, for August 20, 1896. The importance of long-range predictions to the agricultural interests of the United States demands that we give our careful attention to the discovery announced by Mr. Russell that, in general, there is a periodicity of nineteen years in the occurrence of droughts. He began by studying the statistics of the records in Australia since 1788, the date of the foundation of the colony of New South Wales, and here first found evidence of a 19-year period. He next found that the droughts of India coincided with those of Australia, so far as the records went, and that he could, by means of the Indian record, plausibly locate the greatest of all the droughts in Australia as having occurred in 1769–70. Up to this time he had not studied the ordinary dry years separately from those in which phenomenal droughts occurred, but had found that bad or droughty years usually came in groups of from three to seven. The end of the first and the beginning of the second year of drought was the date used by him in his studies.

Russell now divided the droughts into first and second class, treating each separately, and proceeded to study European statistics. Between the years 900 and 1896, A. D., the interval of nine hundred and ninety-six years embraces about fifty-two periods of nineteen years each; he found that of the fifty-two repetitions of years when droughts should be expected they were actually present on forty-four of these; of the eight missing years, six occurred between 900 and 1000, A. D., when the historical record is very incomplete. Starting with 1896, and reckoning backward to 900, Russell found 78 droughts in different countries somewhere in the world that fit into the period of recurrence of droughts of the first class. During the same period he found that there should be fifty-one returns of the year that is characterized by second-class droughts, and that history actually records 89 such droughts in different countries on thirty-six of these periods. There is, therefore, a total of 167 droughts between the years 900 and 1896 that occur on the years when droughts are to be expected, according to Russell's 19-year period, and there remain only 41 other droughts on record, scattered through various discordant years; of these latter, 26 are considered by him to belong to a third class, that is irregular in Australia, but more regular and more important in the Northern Hemisphere. Mr. Russell, therefore, claims that out of 208 recorded droughts, 193 fit into his cycle of nineteen years, and that as this cycle has continued for a thousand years, so it may be trusted to justify forecasts based upon it.

Going farther back in history, our author finds that of 20 droughts recorded in B. C. years, 19 fit into his drought cycle, and the fact of such a remarkable agreement is urged as a confirmation of the historical chronology, although it seems reasoning in a circle. The drought predicted to Pharaoh by Joseph apparently belongs to the same period as that predicted by Elijah forty-two cycles (or forty-two times nineteen years) later; the drought predicted by Elisha occurred nineteen years, or one cycle, after that of Elijah, and these ancient predictions seem to Russell to show that the Egyptians and Jews knew of this 19-year period. He even considers it possible that the records kept by the Assyrians since the year 3800 B. C. must have shown them this 19-year period in droughts, as it is known to have also shown them the similar period of eighteen years in eclipses.

Russell further finds that red rains, due to red dust floating in the atmosphere, argue the prevalence of very dusty weather; at least, it is true that in New South Wales red rain and red dust immediately attend severe droughts. He finds that, beginning with the year 738 B. C., there are 69 recorded falls of red rain, every one of which fits into his 19-year cycle. If these were really due to droughts, then they add ten more records of drought years to the one hundred and ninety-three quoted above, and leave only five years on which no droughts are recorded out of two hundred and eight years in which they should have occurred according to Russell's cycle. But, furthermore, Mr. Russell states that great hurricanes, great frosts, and even the wet years and the fluctuations of the great lakes of the world, all fit into this cycle. Finally, he suggests that, as these statistics all point toward a lunar influence, he has, therefore, examined this subject with the following results:

1. Great droughts of the first class occur in the years when the dates of eclipses accumulate near March 21 and September 21.

2. Droughts of the second class (of shorter duration, but more intense than those of the first class), together with gales and hurricanes, occur when the dates of eclipses accumulate in February or just before March 21 and in August or just before September 21.

3. Droughts that are less severe in intensity than those of the first class, but last much longer than those of the second class, occur when the dates of eclipses accumulate in April or just after March 21 and in October, or just after September 21.

Remarks on the above.—For some years past the search for periodicities in meteorological phenomena has apparently abated; the small value of the so-called sun spot or 11-year period in recent years seemed to show that after all there were no important astronomical periodicities in meteorology, and students have therefore directed their attention more to the complex results that flow from the variations of moisture and of insolation combined with the irregularities of the earth's surface. It has, in fact, been very plausibly shown to be probable that no long-continued periodicity can be maintained in the atmosphere by the annual and diurnal changes in insolation, and that if such periods exist they must be maintained (or their existence must be forced) by the direct action of some external body. Inasmuch as the 11-year sun spot and the 28-day lunar periods are rarely appreciable and inasmuch as Laplace has shown that solar and lunar semidiurnal tidal waves in the atmosphere, due to the action of gravitation, must be inappreciable it would seem that there is very little reason left to expect any other periodicity to be forced upon the atmosphere. On the other hand Mons. A. Poincaré, of the Meteorological Society of France, by a laborious study of the daily international maps of the Northern Hemisphere showed that there is a small systematic periodic northward and southward movement of the large areas of high pressure that form a permanent feature of the Atlantic and Pacific Oceans, and that this movement depends upon the movement of the moon from the north to the south side of the earth's equator, or *vice versa*, in the course of its monthly revolution around the earth in its own orbit. This oscillation north and south of the tropical areas of high pressure is therefore a semimonthly or 14-day lunar tide. By virtue of this tide the regions of easterly trades and of westerly winds have their boundaries periodically displaced and any one station near their boundaries would probably experience a variation in the intensity and direction of the wind depending upon the lunar month; probably a similar variation in rainfall and cloudiness would also be found for such locations, but not necessarily for the world in general.

It is evident that when the sun and moon conspire, that is to say, when both are north of the equator, or both south,

these tidal influences will be most conspicuous, and this is what happens when eclipses occur. Inasmuch as eclipses recur every eighteen years and eleven and one-third days one would therefore naturally look for an 18-year period superposed upon the lunar monthly period already indicated and this 18-year period would show itself not only in the time of occurrence, but especially in the intensity of the disturbances. For example, if the high area, with its northeast winds and clear skies, which brings dry weather to Spain and Portugal, moves eastward or northward whenever the moon is farthest north of the equator, and especially so when the sun is also farthest north, then this combination (which occurred on the 28th of June, 1878, and on the 8th of July, 1896,) should mark the year when droughts may be expected in that region; of course the rainy regions are also pushed farther north in Europe and Great Britain. During the whole of the years 1878 and 1896 the moon attained extreme northerly and southerly positions, and under the tidal influence of the moon there was a tendency of the areas of high pressure throughout the world to assume a more northerly position than in 1887, which is midway between.

If the semimonthly lunar tide, explained in the previous paragraph, has any influence on the tropical areas of high pressure and on the weather at their boundaries, then when the moon is persistently farthest north in combination with the sun, as in the summers of 1878 and 1896, we ought to have relatively warm, clear, dry weather in western Europe and on the west coast of North America; relatively cold and rainy weather south of latitude 40° S. in Australia and South America; relatively dry, warm, and clear in the rest of Australia, in southern Africa, and on the west coast of South America. It is plausible that by assembling a large number of predictions, based on the general circulation of the atmosphere one may demonstrate that during the last half century, or since the beginning of the publication of daily weather maps there has been an appreciable connection between the motions of the moon and the general character of the seasons on the borders of the great areas of high pressure. Inasmuch, however, as the lunar tidal influence can stimulate the production of rain in one region of the globe while it simultaneously produces drought in another, therefore one must be very careful not to consider the droughts in any two regions as confirmatory of the lunar influence unless these regions have the proper geographical situation relative to the areas of high pressure, and unless corresponding unusual rains occur in other properly located regions.

As a rule, droughts that are sufficiently severe to seriously affect crops or produce famine, are, in the United States, the culmination of several years of rains so light that the ground has become dried out to a considerable depth, they are, however, distinctly of a local character, rarely covering twenty-five square degrees. They represent small spots of great deficiency, while a larger area of general deficiency exists near by, and other areas of excess exist farther away. From our limited point of view we consider the locations of these areas to be determined by accidental causes, the general outcome of which is the formation of areas of descending air, clear sky, and less than normal rainfall. But there are some cases in which the drought is due to the weakness of the horizontal wind, as in India, where a failure of the southwest monsoon—or in the Island of St. Helena, where the failure of the southeast trade—or the Barbadoes, where the failure of the northeast trade is disastrous; these are cases where the ordinary rain depends directly upon the ascent of air that is pushed from the lower stratum up over hills and mountains. One should be very careful about combining the records of droughts in these localities with the records from regions where rainfall is due to more general causes. Again, the records of famine in lower Egypt have little or no relation

to the rainfall in that country but depend entirely upon the proper utilization of the annual overflow of the Nile, whose waters come from two sources, Abyssinia and Central Africa. This water supply for the Nile depends, like that of the Mississippi, upon two or three rainy regions, each of which is governed by its own laws. We should fall into hopeless confusion if we should indiscriminately combine together the records of droughts in such various climatic regions in hopes of deducing natural periodicities or other meteorological laws.

ON HIGHS AND LOWS.

A correspondent in Dublin, Ind., requests the Editor of the REVIEW to give its readers "some information on high and low in regard to the barometer; it is not clear to some whether high refers to the long or short arm of the mercury and low *vice versa.*"

The words "high" and "low" are used as contractions for "high pressure" and "low pressure." Inasmuch as atmospheric pressure is measured by the barometer, these expressions are also equivalent to saying that the column of mercury in the barometer is a tall or a short one. If a syphon barometer is used, the top of the long column is above the top of the short column by a larger or smaller amount; the difference in height between the tops of the long and short column is usually more than 30 inches when the pressure is high and less than 30 inches when the pressure is low and when the station is near sea level. If an aneroid barometer is used, the index or pointer usually turns toward the right hand for higher pressures and toward the left hand for lower pressures.

If the reader has access to a map showing the condition of the atmosphere at any time, and such weather maps are distributed by thousands every day, he will perceive that the published barometric pressure is expressed in inches and hundredths and that the height of the barometric column ranges between 28 and 31 inches. The map shows, by means of isobaric lines, the regions where the pressure is the same. Some of these isobars inclose a region of high pressure and others a region of low pressure. These regions move along day by day, as shown by successive maps, and the tracks pursued by their centers are published regularly on Charts I and II of the MONTHLY WEATHER REVIEW. High areas are the regions of high barometric pressure and low areas are the regions of relatively low barometric pressure. With the high areas we usually associate cool or cold, dry, clear weather and gentle winds. With the low areas we usually expect warmer, moist, cloudy, and rainy weather and strong winds, and sometimes also thunderstorms, tornadoes, and hailstorms. Therefore, the low areas are sometimes spoken of as storm centers.

The term barometric pressure or simply barometric reading is often used without realizing its meaning in meteorology. Ordinarily we appreciate the temperature of the air by our personal sensations so clearly that when we see a record of 100° F., we instinctively think of the heat and the temperature, and the most ordinary meteorological observer doubtless sees in his mind's eye the relative levity or buoyancy of the air, due to the fact that it is expanded by high temperature. But our nervous organization is not generally sensitive to the ordinary changes of atmospheric pressure; we have not a mechanical sense to tell us of the pressure or push of the ordinary air. Occasionally one will be found whose ears ring when the atmospheric pressure is high or whose nerves pain him when the pressure is low. To the meteorologist, however, the expression high or low pressure conveys an idea of force exerted in compressing the atmosphere and of expansive force within every cubic inch by which it tries to enlarge its boundary. To him a high barometer means that the air is being condensed by pressure, and *vice versa* a low barometer that the air is expanding by reason of the relief of pressure. The pressure ordinarily exerted by the atmosphere is about 15 pounds to the square inch. This pressure would balance the weight of a column of ·mercury 1 inch square and 30 inches high. This is the pressure that is holding every cubic inch of our lower atmosphere within its bounds; if the pressure relaxes the cubic inch of air expands. If, for instance, the weather map shows that a region of low pressure is advancing upon any station, the observer may expect to find the air within any confined space push outward through every possible aperture; the air in the soil comes up; that within a cavern pushes out through the entrance; bubbles of air in liquids expand in size; hermetically sealed cans bulge outward. These and similar phenomena show the observer that the pressure of the atmosphere upon all bodies at the surface of the earth has diminished and that internal pressures that before were counterbalanced by the atmospheric pressure now have the preponderance. The force that pushes the air forward when the wind blows is this atmospheric pressure of about 15 pounds to the square inch, or rather it is the difference in atmospheric pressure, since the full pressure of 15 pounds to the square inch could only come into play when the air or wind is blowing into an absolute vacuum.

The motion of the wind is the result of pressure from behind just as truly as is the motion of the piston rod of a locomotive engine. The piston usually has the atmospheric pressure of 15 pounds to the square inch on one side of it and the steam pressure of 100 or 200 pounds to the square inch on the other side, and this great difference of pressure is necessary in order that so small a piston may do so much work. The pressure and the action of the steam engine piston are intense. On the other hand, in the atmosphere a small portion of air moving along as a rapid wind has a very little excess of pressure in the rear over that in front. A vertical sheet of air 1 foot thick moving forward as the front of a violent gust may, for instance, have a pressure of 29.50 inches in front and 29.51 inches in the rear; this difference of .01 of an inch is about $\frac{1}{2950}$ of the whole pressure, or about 0.005 pounds per square inch, or 0.72 pounds per square foot. Now, a cubic foot of air weighs about $\frac{7}{100}$ of a pound, and as the above force is continuously pushing this mass, it soon gives it a great velocity, and maintains it at that velocity by continuously overcoming friction and other resistances. The atmospheric pressure pushing from all sides toward a region of low pressure soon sets the air into a whirling motion; it may be on a very small scale, forming a waterspout or a tornado that would scarcely make any show on our daily weather map, or it may be in great whirls, such as constitute hurricanes or other cyclonic storms, and which are those treated of in the chapter on areas of low pressure.

METEOROLOGICAL TABLES.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only the 8 p. m. observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation.